LIQUID SAMPLING

This invention relates to sampling a liquid medium, such as for determination of the composition thereof or of contaminants therein, concerning especially repetitive sampling accomplished by use of a pressurized fluid for sample propulsion.

Manual techniques for sampling a body of liquid are giving way to automatic sampling procedures, usually electrically operated. Where electricity is unavailable, inconvenient, or hazardous, it has become customary to use compressed gas not only as a propulsion fluid but also to control the sampling repetition frequency. Whenever the volume of liquid at, or flowing past, a given sampling locus is variable, it is desirable, in the interest of a more representative result, to vary the sampling frequency or sample volume (or both) in accordance therewith. The net effect is to proportion the volume of liquid obtained in the form of samples to the total volume of liquid in the body from the beginning to the end of the overall time period within which samples were taken. Conventional practice relies upon impulses provided from separate measuring devices, usually electrical, to trigger the sampling.

A primary object of the present invention is depth-proportional liquid sampling without electrical actuation.

Another object is provision of pressure-actuated depth-proportional means for sampling liquids.

A further object is adaptation of a depth-proportional sampling accessory to a variety of gas-actuated liquid-sampling equipment.

Other objects of the present invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams.

FIG. 1 is a schematic, largely block, diagram of apparatus useful according to this invention;

FIG. 2 is a schematic diagram of the practice of the invention in conjunction with a first embodiment of liquid-sampling apparatus;

FIG. 3 is a schematic diagram of the practice of the invention in conjunction with a second embodiment of liquid sampler; and

FIG. 4 is a schematic diagram of the practice of the invention in conjunction with a third embodiment of similar apparatus.

In general, the objects of the present invention are accomplished, in sampling of liquid from a body thereof at a given locus therein to a collection location wherein accumulation of fluid is utilized to determine sampling frequency, by bleeding off fluid from such accumulation against back pressure of the body of liquid at the sampling locus therein and thereby relating the quantity of liquid collected to the depth at the sampling locus.

The invention contemplates, in apparatus for sampling liquid, a source of fluid at superatmospheric pressure, valve means regulating flow of fluid from the source to a locus of accumulation thereof, means interconnecting the locus of fluid accumulation to the liquid to be sampled to bleed fluid off against back pressure of the liquid, and means separately interconnected to such locus and responsive to the pressure of such fluid accumulation for effecting sampling of the liquid whenever a certain pressure thereof is reached.

FIG. 1 shows in block form, with double-line or tubular interconnections, a Propulsion Fluid Source providing fluid continuously (solid arrow) to a Liquid Sampler from which fluid is supplied intermittently (broken arrow) to a Sampling Chamber having provision for liqiud intake (openings) under the surface of a body of liquid (shaded). Some of the fluid flows continuously from the Liquid Sampler to a Depth Device and then bubbles continually out from the open bottom end of depth tube D extending downward to the level of the Sampling Chamber intake. Samples of liquid collected therein are propelled from time to time into a Collection Vessel by the discontinuous flow of propulsion fluid. The end of the bubbler tube is shown inside partial enclosure E (shown schematically) to protect it from effects of liquid flow such as might adversely affect the static back pressure. The pressure at such depth may be read on meter or indicator R (suitably located to be readily visible, here shown just outside enclosure E) to facilitate calibration or may be calculated from knowledge of the depth.

As subsequently indicated, the Depth Device comprises valving appropriate to the task. Shown in each of the subsequent views, the preferred valving includes valve V_{10}, which is simply an on-off control that in the latter position incapacitates the device; valve V_{11}, which is a pressure-regulator capable of providing constant fluid pressure downstream therefrom; valve V_{12}, which is an adjustable flow-regulator; and valve V_{13}, which is a two-position three-way valve, normally open to the end of the bubbler tube but with an alternative closed position, in which the part of the bubbler tube upstream is vented to the atmosphere, as is useful during calibration.

FIG. 2 illustrates use of such a depth device and bubbler tube in conjunction with an embodiment of liquid-sampling apparatus such as is disclosed in Blechman U.S. Patent application Ser. No. 139,759 filed 3 May 1971, whose disclosure is incorporated by reference herein, especially to the extent not set forth below. Source **10** of fluid under pressure delivers fluid through on-off valve V_I, coupling **1**, flow-regulating valve V_{II}, and flowmeter **2** into conduit **3**. Conduit **3** joins conduit **3***a*, which leads to ballast or surge tank **4**; conduit **5**, which leads through pressure-responsive switching (snap action) valve V_{III} to sampling chamber **6**; and conduit **3***e* containing the valves of the depth device, terminating in the bubbler tube with outlet end **3***g*. The fluid pressure at the conjunction of those conduits appears on meter or indicator M. Valve V_{III} is normally closed until whenever the pressure in sensing tube **5***a* from fluid accumulating upstream thereof attains a preset actuating pressure, whereupon the valve opens and interconnects surge tank **4** to sampling chamber **6**.

Resulting fluid pressure in the sampling chamber closes a check valve therein (not shown) between the chamber and the surrounding liquid and forces the sample of liquid therein through conduit **7** into collection vessel **8**. Excess propulsion fluid is vented from the collection vessel to the atmosphere through vent tube **9**. When the pressure immediately upstream of valve V_{III} falls sufficiently the valve recloses, venting the sampling chamber to the atmosphere through vent **3***b* of valve V_{III}, whereupon the next sample of liquid enters the sampling chamber through the check valve therein.